
ENVIRONMENTAL Fact Sheet



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MtBE in Drinking Water

WHAT IS MtBE?

MtBE is the abbreviation for the compound **methyl tertiary butyl ether**. This compound is a colorless liquid at room temperature and pressure. MtBE is manmade and thus its presence in water indicates that manmade contamination exists in the recharge area of the well. MtBE degrades very slowly, is highly soluble in water, has a very small molecular structure and has very low taste and odor thresholds.

WHERE IS MtBE USED?

MtBE was used to increase the octane rating of gasoline and reduce air pollution by increasing the oxygen content of gasoline. It was first introduced into gasoline in 1979 as lead was being phased out. The 1990 amendments to the federal Clean Air Act required the reformulation of some gasoline to increase the oxygen content. MtBE is an ether and contains 18 percent oxygen. The oxygen requirement in the Clean Air Act prompted the petroleum industry to increase the percentage of MtBE used in gasoline in some areas of New England to about 11 percent. There are few other uses of MtBE in normal commerce or industry. New Hampshire banned the use of MtBE in all gasoline beginning on January 1, 2007.

WHAT ARE THE HEALTH EFFECTS?

The EPA in the Safe Drinking Water Act (SDWA) has not set a formal health based drinking water standard, known as a maximum contaminant level (MCL), for MtBE. The DES Environmental Health Program has developed a recommended **health-based** drinking water standard for community public water systems for MtBE of 13 micrograms per liter ($\mu\text{g/L}$). DES has adopted that value as an MCL in New Hampshire's Safe Drinking Water Act program. Studies with animals suggest drinking water with high levels of MtBE may cause stomach irritation, liver and kidney damage and nervous system effects. An increase in liver and kidney cancer was found in rats and mice breathing high levels of MtBE or orally consuming high concentrations of the chemical. Because of the animal studies on MtBE, the bureau considers MtBE as a possible human carcinogen. A health information summary for MtBE is available at www.des.nh.gov by clicking on "publications/fact sheets" in the Quick Links, then going to the "Environmental Health" fact sheets and choosing ARD-EHP-2.

The EPA's public water supply program made a **non-health** based recommendation to limit MtBE in drinking water to 20-40 micrograms per liter ($\mu\text{g/L}$). This recommendation is based on preventing taste and odor complaints. MtBE has a very low odor threshold level at 20 $\mu\text{g/L}$, while the threshold level for taste is 40 $\mu\text{g/L}$, although some individuals may be able to detect the chemical at concentrations as low as 1 $\mu\text{g/L}$.

ASSISTANCE FROM DES

If you have MtBE in your water supply, DES may be able to provide assistance to you in two areas:

1. DES may assist in identifying the origin of the contamination. Please call the DES Oil Remediation and Compliance Bureau at 271-3644 for assistance.
2. New Hampshire has special funds that may be able to provide financial assistance to abate pollution from fuels such as from heating oil or gasoline including MtBE. Information regarding these funds is contained in the Petroleum Reimbursement Funds Information Packet. These funds are also administered by the DES Oil Remediation and Compliance Bureau.
3. In situations where the source of the MtBE contamination is unknown, funding may be available from the Gasoline Remediation and Elimination of Ethers Fund. This fund was set up to treat drinking water to remove MtBE from public and private water supplies.

HOW CAN MtBE BE REMOVED FROM DRINKING WATER?

Unlike many other constituents associated with hydrocarbons, MtBE is difficult to remove from water. There are generally three treatment methods that have been shown to be effective in removing hydrocarbon organics from drinking water: air stripping, adsorption using activated carbon, and oxidation. Effective treatment methods are discussed below.

If the concentration of the contaminants is high, two treatment units (typically using different methods) are often installed. The first process is used to remove the "heavy" contaminant load while the second provides a "polishing" step to assure full removal of the contaminant(s) and to address "breakthrough." Air stripping is often the first method used while activated carbon is often used as the polishing step.

Air Stripping Treatment: Advantages and Disadvantages

Air stripping treatment consists of passing large amounts of air through the contaminated water. The efficiency of the device is improved by breaking up the bulk of the water into many small droplets. The goal is to allow the contaminants to volatilize into the air. When air stripping is used, two operational problems are possible:

- If there are elevated levels of iron or manganese in the water, rusty precipitate staining of fixtures and clothing is likely. iron/manganese pretreatment maybe necessary.
- Bacterial slime may grow in the air stripper, causing clogging. This will require occasional cleaning or continuous or periodic chlorination.

The advantage of air stripping is that there is no disposal or regeneration of the treatment media necessary.

Activated Carbon Treatment: Advantages and Disadvantages

Activated carbon has enormous surface area within each carbon particle. One pound of activated carbon has a surface area greater than the size of a football field. Activated carbon is a material that attracts many types of organic contaminants to its surface. Once the removal capacity of the carbon is used up, it may be returned to the manufacturer for rejuvenation (for very large users) or can be disposed of appropriately for smaller situations. Some activated carbons are now produced that specifically target MtBE.

If activated carbon is used, the radon and mineral radioactivity concentrations of the water should be determined. Activated carbon concentrates radon, potentially creating a low level radionuclide waste and possible source of increased radiation within the home. Activated carbon can also foster the growth of bacteria by concentrating other organics which can be used as a food source on its surface. A final concern with activated carbon is the possible release of contaminants after they have been initially adsorbed. This action is known as desorption or dumping. This could occur if other ambient water quality characteristics change.

To address breakthrough and desorption, the overall amount of activated carbon could be divided into two treatment tanks and the two devices installed in a “series” configuration, where water flows through the first unit and then into the second. In such an arrangement any breakthrough from the first unit can be adsorbed by the unused carbon in the second unit. The advantage of activated carbon treatment in pressure tanks compared to other methods is that the water does not need to be repressurized and is less likely to become contaminated by dust and other airborne contaminants. The disadvantage is that carbon attracts organic matter from the water and thus typically supports an elevated concentration of bacteria on its surface. Also, carbon has a low capacity of attracting MtBE compared to other organic compounds and must be replaced more frequently.

Other Possible Treatments for MtBE

New methodologies still in the trial or experimental stage include:

1. Oxidation Treatment: Advantages and Disadvantages

Certain organic contaminants will chemically react with oxygen and oxygen-like compounds. After oxidation treatment, the resultant compounds may be fully oxidized, may have a lower level of hazard, or may be more amenable to treatment by other means. Further treatment may still be necessary, however. Oxidizing chemicals could include potassium permanganate, (KMnO_4), hydrogen peroxide (H_2O_2), and ozone (O_3).

2. UV/Ozone Destruction

One newer treatment technique, which is now being evaluated, is the use of ultraviolet radiation in conjunction with ozone to break down MtBE. This treatment injects ozone into the water and the mixture is passed through UV light. The UV light “excites” the ozone, forming stronger oxidizing compounds which then break down the MtBE. Presently, there are a limited number of these treatment processes in operation, with very few on a small scale, and thus costs are high and operational effectiveness can vary with the level of maintenance.

For information on treatment systems, visit the fact sheets webpage at

<http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm> and scroll down to DWGB-2-5, entitled “Considerations When Purchasing Water Treatment Equipment.” A treatment system should not be purchased until sufficient water quality testing has been done to identify all of the following:

1. The short term variability of the contaminant(s).
2. Whether the contaminant concentrations are rising or falling over the long term.
3. Other contaminants that are in the general area and how many are predicted to affect the well in the future.

MONITORING PROGRAM AFTER INSTALLATION OF A TREATMENT SYSTEM

Periodic laboratory testing should be done of both the raw and finished water to determine treatment effectiveness. The frequency of this monitoring would be determined based on variability and duration of the past sampling record and other site specific conditions. Where activated carbon is used, the carbon will lose its removal capacity and will need to be replaced in time. A monitoring program will be needed to predict the expected longevity of each new carbon recharge.

LABORATORY TESTING

The DES Laboratory and many commercial laboratories can test for MtBE and other volatile compounds. The DES cost is \$120 for each sample. This test provides information for all of the volatile industrial solvents and hydrocarbons regulated under the Safe Drinking Water Act. MtBE can vary in concentration, thus two or more samples should be taken before judging the average MtBE concentration in a well. Subsequent sampling for just MtBE alone will be performed by the State Laboratory for \$60. The DES laboratory can be contacted at 271-3445 or 271-3446.

FOR MORE INFORMATION

For additional information, please contact the Drinking Water and Groundwater Bureau at (603) 271-2513 or dwgbinfo@des.nh.gov or visit www.des.nh.gov, click on A-Z List and choose Drinking Water and Groundwater Bureau. All of the bureau’s fact sheets are on-line at <http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/index.htm>.

Note: This fact sheet is accurate as of January 2009. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.